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Aspen Overstory Recruitment in Northern Yellowstone National Park During the Last 200 Years

Eric J. Larsen¹ and William J. Ripple²

Abstract—Using a monograph provided by Warren (1926) and two sets of aspen increment cores collected in 1997 and 1998, we analyzed aspen overstory recruitment in Yellowstone National Park (YNP) over the past 200 years. We found that successful aspen overstory recruitment occurred on the northern range of YNP from the middle to late 1700s until the 1920s, after which it essentially ceased. We hypothesized why the browsing influence of Rocky Mountain elk (*Cervus elaphus*) may be different now than it was historically. At a landscape scale, elk hunting outside YNP may be a significant factor changing elk foraging behavior. At a finer scale, elk foraging patterns and behavior due to predation risk may have been altered with the removal of the gray wolf (*Canis lupus*) from YNP in the early 1900s. Wolves may positively influence aspen overstory recruitment through a trophic cascades effect by reducing elk populations and decreasing herbivory on aspen by modifying elk foraging patterns and behavior.

Project Description

Quantitative data concerning aspen (*Populus tremuloides*) overstory recruitment in Yellowstone National Park (YNP) prior to park establishment (1872) is scarce or nonexistent. In 1921 and 1922, Edward R. Warren (1926) conducted one of the few early quantitative studies of YNP aspen during the course of his investigations into the habits of the beaver (*Castor canadensis*) inhabiting the Park's northern range. We used the diameter measurements provided by Warren (1926) to study historic patterns of aspen overstory regeneration in YNP (Ripple and Larsen 2000). In 1997 and 1998 we collected 30 aspen increment cores from riparian aspen stands on YNP's northern range and 19 increment cores from the Eagle Creek drainage in the Gallatin National Forest immediately north of the Park. We restricted our sampling to riparian aspen stands to best approximate the aspen habitat type measured by Warren (1926). Using these 49 riparian aspen cores and a dissecting microscope, we counted the growth rings and developed a linear regression equation using their age/diameter relationship.

To analyze the current age distribution of overstory aspen, we collected a second set of aspen increment cores on YNP's northern range. We collected 98 cores from 57 randomly selected stands located in all aspen habitat types. From these increment cores we developed a current aspen age distribution for the northern range.

Results

Applying the regression equation to Warren's (1926) data, we showed that the overstory aspen occurring on the northern range during the early 1920s originated from approximately the 1750s to 1920.

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Combining the results of our current age distribution and the predicted ages of the trees measured by Warren (1926), we concluded that aspen stands were successful in recruiting new stems into their overstory from the middle to late 1700s to the 1920s, and unsuccessful thereafter. As an exception, it appears a few aspen sprouts are surviving in piles of coarse woody debris from fallen conifers killed in the 1988 fires (Ripple and Larsen, in press).

Discussion

We hypothesized that the lack of aspen recruitment since the 1920s may be partially due to the loss of predator/prey relationships between wolves and elk. For prey species, foraging decisions made under the risk of predation may differ from an optimal foraging strategy based only on maximizing nutrient intake (Lima and Dill 1990). Both moose (*Alces alces*) and caribou (*Rangifer caribou*) have been shown to choose lower quality foraging areas with associated lower predation risks in some instances (Edwards 1983; Ferguson 1988). In YNP, elk may have historically avoided extensive foraging in certain high quality habitats such as aspen stands and riparian areas due to the risk of predation from wolves. We suggest that predation risk effects can have a spatially specific influence on elk herbivory at multiple scales. At a broad landscape scale, hunting north of the YNP boundary may have created differential predation risks for elk and a change in the historic patterns of movement and migration. North of the YNP border, the greater risk of predation may have decreased elk browsing pressure and allowed some recruitment of aspen overstory stems. On the northern range within YNP, wolf predation risks may affect elk foraging behavior in aspen stands at a finer scale. In 1999, we initiated a long-term study of the potential influence of the reintroduced YNP wolves on elk herbivory and aspen overstory regeneration. Our objective is to use permanent plots to compare elk use and aspen regeneration within and outside of three core wolf pack territories on the northern range. Our work with trophic cascades involving aspen, elk, and wolves is part of our ongoing "Aspen Project." The web address for the Aspen Project is www.cof.orst.edu/cof/fr/research/aspen/.

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